Cp633
W72f1

Williams

Fertilizer experiments with wheat.

The Library

of the

University of North Carolina

Collection of North Caroliniana

This book was given by

N.C. Dept. of Agriculture

Cp633.U7af1

Cp 633
W72 #1

THE BULLETIN

OF THE

NORTH CAROLINA DEPARTMENT OF AGRICULTURE

RALEIGH

NOVEMBER, 1923

I. FERTILIZER EXPERIMENTS WITH WHEAT ON PIEDMONT RED CLAY LOAM SOILS

II. WHEAT CULTURE IN NORTH CAROLINA

Published by the State Department of Agriculture for the
AGRICULTURAL EXPERIMENT STATION
of the
NORTH CAROLINA DEPARTMENT OF AGRICULTURE
and the
NORTH CAROLINA STATE COLLEGE OF AGRICULTURE
AND ENGINEERING.
The results published here have been obtained in the Coöperative Work of these Institutions

PUBLISHED MONTHLY AND SENT FREE TO CITIZENS ON APPLICATION
Entered at the Postoffice at Raleigh, N. C., as second-class matter
February 7, 1901, under Act of June 6, 1900.

Digitized by the Internet Archive
in 2019 with funding from
University of North Carolina at Chapel Hill

https://archive.org/details/ifertilizerexper00will

I. FERTILIZER EXPERIMENTS WITH WHEAT ON PIEDMONT RED CLAY LOAM SOILS

II. WHEAT CULTURE IN NORTH CAROLINA

BEING A REPORT ON THE RESULTS OF WORK WITH WHEAT AT IREDELL BRANCH FARM IN 1911-1921 INCLUSIVE

By C. B. Williams, W. F. Pate, F. T. Meacham, S. K. Jackson, and H. B. Mann[1]

Division of Agronomy

GENERAL SUMMARY OF RESULTS

I. The fertilizing of wheat will pay a profit, when the materials are used in the proper proportions and in right amounts. In fact, without the proper use of commercial fertilizers the yields of this crop will seldom be profitable on most soils and under normal market conditions. What the amount and proportion should be for average Piedmont soils is shown by the results of the experiments given on the following pages.

II. On average Piedmont red clay loam soils, nitrogen alone, potash alone, and a combination of nitrogen and potash were used at a loss, in many instances not even producing as much wheat as the plats receiving no fertilizer.

III. Phosphoric acid used alone produced increased yields at good profits in all cases. Nitrogen with phosphoric acid, and potash with phosphoric acid, gave increased yields and profits over the use of phosphoric acid alone. Nitrogen with phosphoric acid gave larger increases of both grain and straw than did potash with phosphoric acid, but the value of the increase was not enough to overcome the greater cost of the treatment. Nitrogen, phosphoric acid, and potash used as a complete fertilizer gave larger returns and profits than did any of the other three constituents used singly, or any two of them combined.

The results of experiments included in Table I show that phosphoric acid is the main controlling constituent for growing wheat, and that the use of nitrogen and potash in lesser amounts is necessary for largest yields and profits.

[1]Credit is due E. L. Worthen, F. N. McDowell, and E. C. Blair for the part they had, during the early history of these experiments, in making them a success.

P12312

IV. Lime when used alone gave an increased yield of more than enough to pay for itself. When used with a complete fertilizer, the yields and profits were greater than when a completer fertilizer alone was used. With the rotation used in this experiment, the use of lime has been found profitable with wheat.

V. The amount of nitrogen in the normal fertilizer (400 pounds per acre) adapted at the beginning and applied to wheat was 3 per cent or twelve pounds per acre. This amount was varied to give six, twelve, twenty-four, and thirty-six pounds of nitrogen to the acre to different comparative plats. The yields and profits increased as the amount of nitrogen in the mixtures was increased, the largest and most profitable returns being secured from the use of thirty-six pounds of nitrogen per acre.

Since phosphoric acid is the first limiting factor in the production of wheat on this type of soil, it is very probable that had the amount of phosphoric acid been increased in the same applications as the nitrogen was increased, larger yields and greater profits per acre would have been secured.

VI. The amount of phosphoric acid in the normal fertilizer (400 pounds per acre) adapted at the beginning of the experiment was 7 per cent or twenty-eight pounds to the acre. This quantity was varied on different plats to give fourteen, twenty-eight, fifty-six, and eighty-four pounds of phosphoric acid to the acre. Increased yields were secured as larger amounts of phosphoric acid were applied, **but the largest net profit was secured from an application of fifty-six pounds of phosphoric acid per acre.** As only twelve pounds of nitrogen was used with the varying applications of phosphoric acid, and it has been shown (Table II) that larger applications of nitrogen were profitable, it is probable that if more nitrogen had been used with the heavier phosphoric acid applications they would have shown larger gains in yield.

VII. The amount of potash in the normal fertilizer (400 pounds per acre) adapted at the beginning and applied to wheat was 1½ per cent or six pounds to the acre. This quantity was varied to give three, six, twelve, and eighteen pounds of potash in the mixtures per acre. The results show that **the largest yield of wheat and greatest profit per acre was secured from the use of six pounds of potash per acre.** The increased yields and profits from the other applications were practically the same.

VIII. The average results show that varying the amounts of the normal fertilizer (400 pounds) to the acre gave increased yields and profits for all the different rates of application. After deducting the cost of the fertilizer, the different quantities used per acre showed the following average profits:

200 pounds of fertilizer per acre gave a profit of.....$ 5.87
400 pounds of fertilizer per acre gave a profit of..... 14.33
600 pounds of fertilizer per acre gave a profit of..... 15.44
800 pounds of fertilizer per acre gave a profit of..... 17.36
1000 pounds of fertilizer per acre gave a profit of..... 18.77

Putting this in a slightly different way, the first 200 pounds of fertilizer on an average gave a profit, after paying for the cost of the fertilizer, of $2.93 for each 100 pounds of fertilizer; an application of 400 pounds, $3.58 per 100 pounds; 600 pounds, $2.57 per 100 pounds; 800 pounds, $2.17 per 100 pounds; and 1,000 pounds, $1.88 per 100 pounds of fertilizer.

IX. For the production of wheat on average upland soils in the Piedmont section of North Carolina, of the same general type and character of the one on which these experiments have been made, and considering all the results as a whole, it is recommended for best results that something like 600 pounds per acre of a fertilizer mixture, analyzing about 10 to 12 per cent available phosphoric acid, 5 per cent nitrogen, and 1 per cent potash be used.

When soils have been built up, the nitrogen in the fertilizer mixture may be considerably reduced or even entirely dispensed with. This condition of the soil should be strived for by all progressive farmers by growing and plowing into the soil suitable leguminous crops and crop residues.

X. From the chemical analysis of the various upland soils of the central and west central part of the State, the indications are that the results herein reported will apply very well to most of them.

I. FERTILIZER EXPERIMENTS WITH WHEAT GROWN ON PIEDMONT RED CLAY LOAM SOILS

In this bulletin are given the results of experiments designed to determine the fertilizer or plant-food needs of wheat grown on Piedmont red clay loam soils. Previous reports, as follows, have been made giving the results of field experiments with other crops grown at the farm and in other parts of the State:

1. Results of Fertilizer and Variety Experiments with Cowpeas on Piedmont Red Clay Loam Soils at the Iredell Farm. (Bulletin, June, 1910.)
2. Results of Fertilizer Experiments with Cotton on Piedmont Red Clay Loam Soils, and Variety, Culture, Fertilization of Cotton on Piedmont Red Clay Loam, Red Clay, and the Valley Soils at the Iredell Farm. (Bulletin, August, 1910.)
3. Results of Fertilizer Experiments with Corn on Piedmont Red Clay Loam, and Variety, Culture, and Fertilization of Corn on Piedmont Red Clay Loam, Red Clay, and Valley Soils at the Iredell Farm. (Bulletin, September, 1910.)
4. Fertilizer Experiments with Cotton on the Sandy Loam Soils (Norfolk Sandy Loams) of the Coastal Plain at the Edgecombe Farm. (Bulletin, April, 1914.)
5. Fertilizer Experiments with Corn on the Sandy Loam Soils (Norfolk Sandy Loams) of the Coastal Plain, and Variety, Culture, and Fertilization of Corn on Sandy Loam Soils at the Edgecombe Farm. (Bulletin, May, 1915.)
6. Fertilizer Experiments with Cotton on Piedmont Cecil Sandy Loam Soils, and Variety, Culture, and Fertilization of Cotton on Piedmont Cecil Sandy Loam and Red Clay Soils of the Central Farm. (Bulletin 227.)
7. Fertilizer Experiments with Corn on Piedmont Cecil Sandy Loam Soils, and Variety, Culture, and Fertilization of Corn on Piedmont Cecil Sandy Loam and Red Clay Soils of the Central Farm. (Bulletin 229.)
8. Report on Mountain Soils. (Bulletin, May, 1911.)
9. Report on Piedmont Soils. (Bulletin, February, 1915.)
10. Report on Coastal Plain Soils. (Bulletin, May, 1918.)
11. County Soil Report, No. 1, of Mecklenburg County. (Bulletin, April, 1917.)
12. County Soil Report, No. 2, of Gaston County. (Bulletin, June, 1917.)
13. County Soil Report, No. 3, of Union County. (Bulletin, July, 1917.)
14. County Soil Report, No. 4, of Cabarrus County. (Bulletin, August, 1917.)
15. Relation of Mineralogical and Chemical Composition of the Fertilizer Requirements of North Carolina Soils. (Technical Bulletin No. 9.)
16. Effect of Different Fertilizing Materials Upon the Maturity of Cotton. (Circular 12.)
17. Composition and Fertilizing Value of Farm Crops and Farm Materials. (Circular 70.)

18. Source, Availability, and Suitability of Different Plant-food Constituents to Different Crops. (Circular 11.)
19. Effect of Applying Commercial Fertilizers to Corn and Cotton by Different Methods. (Circular 8.)
20. Tobacco Culture in North Carolina. (Bulletin 237.)
21. Relative Value of Acid Phosphate and Rock Phosphate for North Carolina Soils. (Bulletin, June, 1920.)
22. Fertilizer Experiments with Wheat on Mountain Soils. Wheat Culture in North Carolina. (Bulletin, July, 1920.)
23. Fertilizer Experiments with Corn on Toxaway Loam (Bottom Soil) and Porter's Loam (Upland Soil) for 1911-1917. Varieties, Culture, and Fertilization of Corn on Mountain Soils. (Bulletin, October, 1922.)

RESULTS REPORTED

In the Piedmont section of the State wheat is an important crop. In fact, it appears to be a crop that, under present conditions, should have a much wider use in the crop rotations of this section than it does. The high prices for wheat and commercial fertilizers during the past few years have stimulated the use of commercial fertilizers in a more discriminating way in the growth of this crop. Wheat is one of the crops, however, that under ordinary conditions will require the exercise of far greater judgment and discrimination for profitable fertilization than such crops as cotton and tobacco, because of the lower selling price as compared to these latter crops.

In this bulletin is recorded the results with wheat on Fields A, B, and C at the Iredell Farm during 1911-1921, inclusive.

LOCATION OF FARM AND CHARACTER OF SOIL

The Iredell Branch farm is located near Statesville, in Iredell County, well up in the Piedmont (foothill) section of the State, the elevation being 950 feet above sea-level. The main type of soil on the farm is Red (Cecil) Clay Loam, the subsoil being a moderately heavy clay, but the surface soil has sufficient sand in it to make it a clay loam rather than a clay, though when freshly plowed it would, to a casual observer, be looked upon as red clay. The main types of soil in the Piedmont are Cecil Sandy Loam (gray land), Red (Cecil) Clay Loam, and Red (Cecil) Clay, the latter two being the predominating types. The clay and clay-loam types are rich in potash, very poor in phosphoric acid, the amount of nitrogen depending upon the organic matter contained in the soil. Analyses of samples of soil from the unfertilized plats on which these experiments were conducted show that the soil contains about the following number of pounds of plant food per acre:

	Surface Soil 6 2/3 inches	*Subsoil 28 inches*
Nitrogen (N)	1,293	2,231
Phosphoric Acid (P_2O_5)	999	7,330
Potash (K_2O)	9,014	32,669
Lime (CaO)	4,585	17,769

THE PLATS

The plats on which these experiments were conducted were embraced in Fields A, B, and C. Fields A and B had been long in cultivation and were badly run down when work was started on them in 1903. The plats in Field A were laid off in two series parallel to each other, there being twenty plats to the series, with a driveway or turn-way between plats. The plats are one-tenth of an acre in size or 217.8 feet by 20 feet, with space between plats sufficient for two rows of cotton or other crops, the row on either side of each plat being fertilized like the plat which it adjoins.

The plats in Field B were laid out in a similar way to those of Field A, and were of the same size.

The plats in Field C were part of an old field, covered with broomsedge, small briars, and small pines, in 1903. The pines were grubbed out and the other growth turned under with a two-horse plow in the spring of 1903 and cultivated in corn that year with a fertilizer application of 300 pounds per acre of a normal corn mixture. In the fall of 1903 crimson clover was sown, but no stand was obtained. The land was prepared in the spring of 1904 and laid off into plats of one-twentieth acre each, the size being 108.9 feet by 20 feet, with space between plats for one unfertilized row. There is a four-foot space at the ends of the plats. There are two series of sixteen plats each in this field, with driveway or turn-way between.

In the case of all plats on this farm, there is a four-foot extra space at the ends of the plats.

Field A. These plats were used for fertilizer experiments with cotton in 1903, 1904, and 1906; for fertilizer experiments with corn in 1905, 1907, and 1910; for general crop of oats without fertilizer in the fall and spring of 1908; for fertilizer experiments with peas in the summer of 1908; and for fertilizer experiments with cotton in 1909. In case of each of three crops, the same plan or system of fertilization was followed. By this is meant that plat one in all cases received only nitrogen; plat two, phosphoric acid; plat three, potash, and so on, though the quantities actually applied varied with the three crops. The fertilization of the cotton plats was based on a normal application of 400 pounds per acre of a mixture containing 7 per cent available phosphoric acid and 2½ per cent each of nitrogen and potash. The fertilization for corn was based on a normal application of 300 pounds per acre of a mixture containing 7 per cent available phosphoric acid, 3 per cent nitrogen, and 1½ per cent potash. For peas, the fertilization was based on a normal application of 300 pounds per acre of a mixture containing 8 per cent available phosphoric acid, 1 per cent nitrogen, and 4 per cent potash.

Field B. These plats were used for fertilizer experiments with corn in 1903, 1904, 1906, and 1908; for fertilizer experiments with cotton in 1905, 1907, and 1910; for general crop of oats without fertilizer in the fall and spring of 1909; and for fertilizer experiments with peas in the summer of 1909.

Field C. These plats were used for fertilizer experiments with peas in 1904, 1905, 1906, and 1907; a grain crop without fertilization preceding the pea crop in each year except for 1904; for fertilizer experiments with cotton in 1908, with corn in 1909; and oats followed by cowpeas for seed in 1910.

In 1910, the rotation on these fields was changed from that outlined above to the following:

First year—Cotton, rye, on Field B in 1910.
Second year—Corn on Field A in 1910.
Third year—Wheat, red clover, on Field C[1] in 1913.
Fourth year—Red clover on Field A in 1912.

PREPARATION AND CULTIVATION

The land in all cases was well prepared by breaking with a two-horse turning plow after the previous crop had been removed by cutting. After breaking, the land was allowed to settle for a few weeks, after which it was conditioned by harrowing immediately before the seeding. Leap's Prolific variety of wheat was used in seeding all the experiments, and approximately 1½ bushels of seed were put in with the drill during the early fall.

FERTILIZATION AND FERTILIZING MATERIALS

The fertilizer for all the plats was weighed separately for each plat and applied broadcast by hand just before the wheat was drilled. Acid phosphate was used as the source of phosphoric acid, dried blood for nitrogen, manure salt for potash, and finely ground limestone for lime. The fertilizing materials were analyzed each year and applications were made on the basis of actual analyses so as to give the exact quantities of nitrogen, phosphoric acid, and potash indicated for each plat. For the sake of simplicity and convenience in presenting the results of a number of years experiments, the fertilizer applications are expressed in terms of acid phosphate, containing 16 per cent available phosphoric acid; dried blood, contaning 13 per cent nitrogen; and manure salt, containing 20 per cent potash, which

[1]Cotton was on Field C in 1911.

figures represent the average composition of these materials. The fertilizer applications in the experiments with wheat are on the basis of 400 pounds per acre for the normal (NPK) application of a mixture containing 7 per cent available phosphoric acid, 3 per cent nitrogen, and 1½ per cent potash. Lime, in the form of finely ground limestone, was applied broadcast at the rate of 2,000 pounds per acre every four years, beginning in 1910. The fertilizer applications in the tables, in addition to being represented in terms of acid phosphate, dried blood, and manure salt, are also indicated by the symbols, N, P, K, and L, which have the following significance:

N equals nitrogen at the rate of 12 pounds per acre or 92.3 pounds of 13 per cent dried blood.

P equals phosphoric acid at the rate of 28 pounds per acre or 175 pounds of 16 per cent acid phosphate.

K equals potash at the rate of 6 pounds per acre or 30 pounds of 20 per cent manure salt.

L equals lime at the rate of 2,000 pounds per acre of actual calcium carbonate in the form of ground limestone every four years broadcast.

There are columns in the tables showing the actual weights in pounds of phosphoric acid, nitrogen, and potash applied to each plat (expressed on acre basis) which will enable anyone to use the same amounts of fertilizing constituents from other materials, if so desired. The following average prices, which fairly represent the cost of the several materials to the farmer at the present time, have been assumed for the materials used:

16 per cent acid phosphate	$22.40 per ton
13 per cent dried blood	93.60 per ton
20 per cent manure salt	60.50 per ton
Finely ground limestone	5.00 per ton

The arrangements of the plats and scheme of fertilizer application are shown by the following:

The normal fertilizer application was 400 pounds per acre of a mixture containing—

Phosphoric acid	7 per cent
Nitrogen	3 per cent
Potash	1½ per cent

Of this normal application—

N equals 12 pounds of nitrogen or 92.3 pounds of 13 per cent dried blood.

P equals 28 pounds of phosphoric acid or 175 pounds of 16 per cent acid phosphate.

K equals 6 pounds of potash or 30 pounds of 20 per cent manure salt.

The experiments were run on Fields A, B, and C, as follows:

Size of Plats, One-tenth Acre
(217.8 x 20 feet)

First Series	*Application*
1	N
2	P
3	K
4	O
5	NP
6	NK
7	PK
8	NPK
9	N½PK
10	N2PK
11	O
12	N3PK
13	NP½K
14	NP2K
15	NP3K
16	NPK½
17	NPK2
18	O
19	NPK3
20	½ (NPK)

Second Series	*Application*
12	1½ (NPK)
22	2 (NPK)
32	2½ (NPK)
42	O
52	NPK—Two applications of nitrogen, ½ as blood at planting, ½ as nitrate of soda later.
62	NPK—Two applications of nitrogen, ½ as nitrate of soda at planting, ½ as nitrate of soda later.
72	NPK—Two applications of nitrogen, ½ as blood at planting, ½ as blood later.
82	NPK—Two sources of nitrogen, ⅕ as nitrate of soda at planting, ⅘ as blood at planting.
92	NPK—Two applications of fertilizer: ½ at planting, ½ later.
112	O
142	Lime—1,000 pounds slaked lime per acre, broadcast every 4th year.
152	NPKL
162	NPK—Fertilizer applied broadcast.
182	O

The above represents the plats in Field A. In Fields B and C they are arranged in a similar way.

METHOD OF DETERMINING THE EFFECTS OF THE DIFFERENT FERTILIZING MATERIALS

The measure of the effect of the fertilizer mixture applied to any plat is equal to the total yield on that plat decreased by the yield of the first unfertilized plat of the group, and further increased or decreased (according as the unfertilized yield decreased or increased from first to last plat of the group) by the product of the difference in the yield of the first and last unfertilized plats of the group by the ratio of the position of the plat in the group to the whole number of plats.

For example:

Let E = True measure of the effect of fertilizer mixture applied.
T = Total yield of that plat under consideration.
A = Yield of first unfertilized plat.
B = Yield of last unfertilized plat in the group.
N_2 = Number of the last plat in group.
N_1 = Number of the first plat in group.
N = Number of the plat to which correction is to be applied.

Then—

$$E = T - A - \frac{N - N_1}{N_2 - N_1}(B - A)$$

WEATHER CONDITIONS DURING THE EXPERIMENT

Soil, seed, fertilization, cultivation, and time of planting influence the crop yield. However, of weather conditions, rainfall is the principal factor to be considered. In the table presented below will be found the monthly and annual rainfall for twelve years, including the years covered by the experiment and the mean monthly and annual rainfall for forty-five years. The rainfall during the months from September to June would effect the growing of wheat in this section of the State. During the fall (September to December inclusive) the rainfall was above normal in 1911, 1912, 1913, 1914, 1918, and 1920; and below normal in 1910, 1916, 1917, 1919, and 1921. In the late winter and spring months, the rainfall was higher than the average in 1912 and 1915; and lower than the average in 1911, 1914, 1918, and 1921.

Rainfall in Inches at Statesville, North Carolina

	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	Means of Observation for 45 Years
January	2.50	4.59	2.49	2.80	4.69	3.55	5.80	3.48	3.89	6.40	5.16	4.53	6.03	3.93
February	2.70	5.68	1.99	5.79	3.20	5.71	4.02	6.09	3.92	1.38	4.60	3.96	4.87	4.45
March	4.00	1.69	4.22	8.92	7.93	3.61	2.27	2.04	8.19	2.81	5.72	6.26	2.20	4.94
April	3.50	2.07	3.75	4.16	2.57	2.37	0.66	2.38	3.50	5.45	4.18	6.78	2.97	3.57
May	5.58	5.40	1.40	7.29	3.93	2.13	7.92	4.32	2.01	2.39	5.32	2.57	3.92	4.08
June	10.67	5.96	5.60	4.45	2.54	1.67	5.93	7.42	3.98	2.55	3.23	3.29	1.65	4.46
July	5.96	4.83	2.59	7.76	3.31	5.12	7.30	15.46	7.08	5.63	13.82	6.68	4.06	5.34
August	4.95	6.49	3.54	1.36	13.71	6.57	10.11	3.46	7.71	4.33	3.59	9.22	2.81	5.80
September	1.58	3.38	1.86	7.99	3.89	2.33	1.64	1.93	3.29	4.30	0.60	4.86	4.16	3.74
October	2.92	4.48	6.13	3.63	4.58	4.44	4.88	2.85	1.95	4.98	4.77	1.00	3.18	3.44
November	1.11	0.34	4.78	2.49	2.14	3.46	3.26	1.13	0.46	2.91	2.61	6.34	2.10	2.73
December	2.52	3.61	5.31	2.15	5.63	9.37	5.61	3.52	1.01	7.23	4.46	5.77	1.83	4.28
Total and mean Annuals	47.99	48.52	43.66	58.79	58.12	50.33	59.40	54.08	46.99	50.36	58.06	60.26	39.78	50.76
Monthly average	4.00	4.04	3.64	4.90	4.84	4.19	4.95	4.51	3.92	4.20	4.84	5.02	3.32	4.23

TABLE I—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Nitrogen, Phosphoric Acid and Potash Alone and in Different Combinations of Two and Three, and Lime Alone and Lime in Addition to a Complete Fertilizer

Results from Field A in 1911, 1915 and 1919

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Yields in Bushels Grain Per Acre				Yields in Pounds Straw Per Acre				Average Increase in Bushels Wheat Per Acre due to Fertilizer	Average Increase in Pounds Straw Per Acre due to Fertilizer	Value of Increase with Wheat at $1.50 per Bu. and Straw at $10 per Ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw over Cost of Fertil.
					1911	1915	1919	Ave.	1911	1915	1919	Ave.					
1	92.3 Lbs. 13% Blood——N=	12	------	------	0.3	0.3	2.2	0.9	20	45	280	115	0.6	—75	$—1.28	$ 2.88	$—4.16
2	175 Lbs. 16% Acid Phosphate—P=	------	28	------	7.3	3.9	1.7	4.3	522	448	220	397	2.8	207	5.24	1.68	3.56
3	30 Lbs. 20% Manure Salt——K=	------	------	6	0.2	0.0	1.0	0.4	22	19	170	70	—1.1	—120	—2.25	0.48	—2.73
4	Unfertilized——O=	------	------	------	0.3	1.2	3.0	1.5	32	88	450	190	------	------	------	------	------
4	Unfertilized——O=	------	------	------	0.3	1.2	3.0	1.5	32	88	450	190	------	------	------	------	------
5	92.3 Lbs. 13% Blood——N= + 175 Lbs. 16% Acid Phosphate—P=	12	28	------	10.9	9.6	9.8	10.1	1386	785	1,000	1,057	8.8	887	17.64	4.56	13.08
6	92.3 Lbs. 13% Blood——N= + 30 Lbs. 20% Manure Salt——K=	12	------	6	0.5	1.6	3.8	2.0	32	125	460	206	0.9	55	1.63	3.36	—1.73
7	175 Lbs. 16% Acid Phosphate—P= + 30 Lbs. 20% Manure Salt——K=	------	28	6	10.8	7.8	7.5	8.7	955	555	700	737	7.8	606	14.73	2.16	12.57
8	92.3 Lbs. 13% Blood——N= + 175 Lbs. 16% Acid Phosphate—P= + 30 Lbs. 20% Manure Salt——K=	12	28	6	13.8	8.3	10.2	10.8	920	530	990	813	10.0	701	18.51	5.04	13.47
11	Unfertilized——O=	------	------	------	0.2	0.0	0.3	0.2	10	28	120	53	------	------	------	------	------
11[2]	Unfertilized——O=	------	------	------	0.3	0.3	2.3	1.0	30	40	350	140	------	------	------	------	------
14[2]	2,000 Lbs. Limestone every 4th Year——L=	------	------	------	2.1	2.3	4.0	2.8	275	140	660	358	0.8	111	1.76	1.25	0.51
15[2]	92.3 Lbs. 13% Blood——N= + 175 Lbs. 16% Acid Phosphate—P= + 30 Lbs. 20% Manure Salt——K= + 2,000 Lbs. Limestone every 4th Year——L=	12	28	6	15.4	13.2	17.0	15.2	1,175	960	1,860	1,332	12.9	1,049	24.60	6.29	18.31
18[2]	Unfertilized——O=	------	------	------	1.3	2.4	6.2	3.3	125	245	800	390	------	------	------	------	------

TABLE I—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Nitrogen, Phosphoric Acid and Potash Alone and in Different Combinations of Two and Three, and Lime Alone and Lime in Addition to a Complete Fertilizer

Results from Field B in 1912, 1916 and 1920

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Yields in Bushels Grain Per Acre				Yields in Pounds Straw Per Acre				Average Increase in Bushels Wheat Per Acre due to Fertilizer	Average Increase in Pounds Straw Per Acre due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bu. and Straw at $10 per Ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw over Cost of Fertil
					1912	1916	1920	Ave.	1912	1916	1920	Ave.					
3	92.3 Lbs. 13% Blood——N=	12	———	———	8.7	4.5	0.0	4.4	198	330	0.0	176	2.4	34	$ 3.77	$ 2.88	$ 0.89
4	175 Lbs. 16% Acid Phosphate—P=	———	28	———	6.3	9.8	5.3	7.1	520	630	695	615	5.1	473	10.02	1.68	8.34
5	Unfertilized——O=	———	———	———	1.3	4.7	0.0	2.0	75	350	0.0	142					
5	Unfertilized——O=	———	———	———	1.3	4.7	0.0	2.0	75	350	0.0	142					
6	30 Lbs. 20% Manure Salt——K=	———	———	6	0.8	3.5	0.0	1.4	105	290	0.0	132	—0.5	—3	—0.77	0.48	—1.25
7	92.3 Lbs. 13% Blood——N=	12	———	———	11.7	12.5	12.2	12.1	1,050	880	715	882	10.4	753	19.37	4.56	14.81
	175 Lbs. 16% Acid Phosphate—P=	———	28	———													
8	92.3 Lbs. 13% Blood——N=	12	———	———	0.8	4.0	0.0	1.6	200	330	0.0	177	0.0	55	0.28	3.36	—3.08
	30 Lbs. 20% Manure Salt——K=	———	———	6													
9	175 Lbs. 16% Acid Phosphate—P=	———	28	———	9.9	11.8	10.8	10.8	1,205	850	925	993	9.3	877	18.34	2.16	16.18
	30 Lbs. 20% Manure Salt——K=	———	———	6													
10	92.3 Lbs. 13% Blood——N=	12	———	———	13.1	13.5	16.9	14.5	1,213	910	985	1,036	13.2	927	24.44	5.04	19.40
	175 Lbs. 16% Acid Phosphate—P=	———	28	———													
	30 Lbs. 20% Manure Salt——K=	———	———	6													
14	Unfertilized——O=	———	———	———	0.3	2.2	0.0	0.8	30	220	0.0	83					
1	2,000 Lbs. Limestone every 4th Year——L=	———	———	———	4.8	2.7	9.6	5.7	610	870	655	712	3.7	570	8.40	1.25	7.15
2	92.3 Lbs. 13% Blood——N=	12	———	———	12.3	13.2	23.7	16.4	1,160	760	1,080	1,000	14.4	858	25.89	6.29	19.60
	175 Lbs. 16% Acid Phosphate—P=	———	28	———													
	30 Lbs. 20% Manure Salt——K=	———	———	6													
	2,000 Lbs. Limestone every 4th Year——L=	———	———	———													
5	Unfertilized——O=	———	———	———	1.3	4.7	0.0	2.0	75	350	0.0	142					

TABLE I—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Nitrogen, Phosphoric Acid and Potash Alone and in Different Combinations of Two and Three, and Lime Alone and Lime in Addition to a Complete Fertilizer

Results from Field C in 1913, 1917 and 1921

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Yields in Bushels Grain Per Acre				Yields in Pounds Straw Per Acre				Average Increase in Bushels Wheat Per Acre due to Fertilizer	Average Increase in Pounds Straw Per Acre due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bu. and Straw at $10 per Ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw over Cost of Fertil.
					1913	1917	1921	Ave.	1913	1917	1921	Ave.					
1	92.3 Lbs. 13% Blood.....N=	12	------	------	1.7	1.0	0.3	1.0	140	60	60	87	—1.0	—105	$—2.03	$ 2.88	$—4.91
2	175 Lbs. 16% Acid Phosphate.P=	------	28	------	12.3	5.3	4.8	7.5	990	360	550	633	5.5	441	10.46	1.68	8.78
3	30 Lbs. 20% Manure Salt.....K=	------	------	6	2.3	0.8	0.3	1.1	190	70	80	113	—0.9	—79	—1.75	0.48	—2.23
4	92.3 Lbs. 13% Blood.....N= + 175 Lbs. 16% Acid Phosphate.P=	12	28	------	16.7	6.3	4.0	9.0	1,500	560	440	833	7.0	641	13.71	4.56	9.15
5	92.3 Lbs. 13% Blood.....N= + 30 Lbs. 20% Manure Salt.....K=	12	------	6	2.8	2.0	0.5	1.8	280	160	110	183	—0.2	—9	—0.35	3.36	—3.71
8	Unfertilized.....O=	------	------	------	3.3	2.3	0.5	2.0	285	200	90	192	--------	--------	--------	--------	--------
8[2]	Unfertilized.....O=	------	------	------	2.5	0.7	0.2	1.1	220	80	50	117	--------	--------	--------	--------	--------
12[2]	175 Lbs. 16% Acid Phosphate.P= + 30 Lbs. 20% Manure Salt.....K=	------	28	6	12.0	4.5	3.5	6.7	940	370	350	553	5.6	436	10.58	2.16	8.42
6	92.3 Lbs. 13% Blood.....N= + 175 Lbs. 16% Acid Phosphate.P= + 30 Lbs. 20% Manure Salt.....K=	12	28	6	15.8	7.0	6.2	9.7	1,550	540	650	913	7.7	721	15.16	5.04	10.12
8	Unfertilized.....O=	------	------	------	3.3	2.3	0.5	2.0	285	200	90	192	--------	--------	--------	--------	--------
8[2]	Unfertilized.....O=	------	------	------	2.5	0.7	0.2	1.1	220	80	50	117	--------	--------	--------	--------	--------
7[2]	2,000 Lbs. Limestone every 4th Year.....L=	------	------	------	7.0	2.5	1.3	3.6	520	210	180	303	2.5	186	4.68	1.25	3.43
9[2]	92.3 Lbs. 13% Blood.....N= + 175 Lbs. 16% Acid Phosphate.P= + 30 Lbs. 20% Manure Salt.....K= + 2,000 Lbs. Limestone every 4th Year.....L=	12	28	6	18.0	4.5	10.0	10.8	1,570	390	980	980	9.7	863	18.87	6.29	12.58

TABLE I—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Nitrogen, Phosphoric Acid and Potash Alone and in Different Combinations of Two and Three, and Lime Alone and Lime in Addition to a Complete Fertilizer

Average Results for Nine Years in Fields A, B and C

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Average Yields in Bushels Grain Per Acre for Years 1911 to 1921 Inclusive	Average Yields in Pounds Straw Per Acre for Years 1911 to 1921 Inclusive	Average Increase in Bushels Wheat Per Acre Due to Fertilizer	Average Increase in Pounds Straw Per Acre Due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bushel and Straw at $10 per ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw Over Cost of Fertil.
1-3-1	92.3 Lbs. 13% Blood N=	12			2.1	126	0.3	—49	$ 0.15	$ 2.88	$—2.73
2-4-2	175 Lbs. 16% Acid Phosphate P=		28		6.3	548	4.5	374	8.57	1.68	6.89
3-6-3	30 Lbs. 20% Manure Salt K=			6	1.0	105	—0.8	—67	—1.59	6.48	—2.07
4-5-8	Unfertilized O=										
5-7-4	92.3 Lbs. 13% Blood N= / 175 Lbs. 16% Acid Phosphate P=	12	28		10.4	924	8.7	760	16.91	4.56	12.35
6-8-5	92.3 Lbs. 13% Blood N= / 30 Lbs. 20% Manure Salt K=	12		6	1.8	189	0.2	34	0.52	3.36	—2.84
7-9-12[2]	175 Lbs. 16% Acid Phosphate P= / 30 Lbs. 20% Manure Salt K=		28	6	8.7	761	7.6	640	14.55	2.16	12.39
8-10-6	92.3 Lbs. 13% Blood N= / 175 Lbs. 16% Acid Phosphate P= / 30 Lbs. 20% Manure Salt K=	12	28	6	11.7	921	10.3	783	19.37	5.04	14.33
(4+11)-(5+14)-8-8[2]*	Unfertilized O=										
(11[2]+18[2])-5-8[2]	Unfertilized O=										
14[2]-1-7[2]	2,000 Lbs. Limestone every 4th Year L=				4.0	458	2.3	289	4.95	1.25	3.70
15[2]-2-9[2]	92.3 Lbs. 13% Blood N= / 175 Lbs. 16% Acid Phosphate P= / 30 Lbs. 20% Manure Salt K= / 2,000 Lbs. Limestone every 4th Year L=	12	28	6	14.1	1,104	12.3	923	23.12	6.29	16.83

*This Plat (8[2]) governs (12[2]) PK Plat

EFFECT OF NITROGEN, PHOSPHORIC ACID, POTASH AND LIME ALONE AND IN COMPARISON WITH EACH OTHER ON THE YIELD OF WHEAT

The experiments, the results of which are presented in Table I, were planned to show the effect on the yield of wheat of nitrogen (N), phosphoric acid (P), and potash (K), when applied singly; when two of the constituents were applied together, as nitrogen and phosphoric acid (NP), nitrogen and potash (NK) and phosphoric acid and potash (PK); and when all three of the constituents were applied to make a complete fertilizer (NPK). Also to test the effects of lime (L) used alone and when used in connection with a complete fertilizer (NPKL).

The results secured are shown in yields of bushels of grain and pounds of straw per acre for the several years, average yields, average increases over the unfertilized (O) plats, which represent the effect of the fertilizer application, the value of the increase, the cost of the fertilizer and the value of the increased yields over the cost of the fertilizer. The value of the increased yields of grain and straw represents the profit from the different fertilizer applications after paying for the fertilizer itself.

Nitrogen (N) (Plats 1, 3 and 1). On Field A, the average results show a loss of 0.6 bushels of grain and 75 pounds of straw from the use of nitrogen; on Field C, a loss of 1.0 bushel of grain and 105 pounds of straw; while on Field B, an average gain was made of 2.4 bushels of grain and 34 pounds of straw. From the average results of all three fields for nine years, the increase due to the application of nitrogen alone was 0.3 of a bushel of grain and a loss in straw of 49 pounds per acre. After deducting the cost of the nitrogen applied, an annual financial loss amounting to $2.73 per acre is shown.

Phosphoric Acid (P) (Plats 2, 4 and 2). Phosphoric acid used alone produced an increase in yield over the unfertilized plats, in all of the nine years on every field. The average increase on Field A was 2.8 bushels of grain and 207 pounds of straw; 5.1 bushels of grain and 473 pounds of straw on Field B; and 5.5 bushels of grain and 441 pounds of straw on Field C. The average increased yields for nine years on the three fields were 6.3 bushels of grain and 548 pounds of straw per acre. After deducting the cost of the fertilizer an annual increase is given of $6.89 per acre.

Potash (K) (Plats 3, 6 and 3). The average results for three years on each field show that the yields from the plats receiving potash alone made less grain and straw than did the unfertilized plats. The average results for nine years show a loss of 0.8 bushels of grain and 67 pounds of straw. The annual potash applications cost 48 cents, making the use of potash alone on wheat show an annual loss of $2.07 per acre.

FIG. 1.—WHEAT ON LAND UNFERTILIZED (PLAT 4—1ST SERIES, FIELD A) SINCE 1903, BUT CULTIVATED AND SEEDED AS OTHER LAND. PHOTO 1923

Nitrogen and Phosphoric Acid (NP) (Plats 5, 7 and 4). From the use of mixtures carrying nitrogen and phosphoric acid, increased yields over the unfertilized plats were obtained in all nine years on each of the three fields. On Field A, the average increase was 8.8 bushels of grain and 887 pounds of straw; on Field B, 10.4 bushels of grain and 753 pounds of straw; and on Field C, 7.0 bushels of grain and 641 pounds of straw; or an average annual increase for the nine years on the three fields of 10.4 bushels of grain and 924 pounds of straw. This increase, after taking care of the cost of the fertilizer, gave an annual net profit of $12.35 per acre. This annual gain was $5.46 more than where phosphoric acid alone was applied, showing that nitrogen has added decidedly to the yield and profit when combined with the phosphoric acid, though the nitrogen when used alone was at a loss.

Nitrogen and Potash (NK) (Plats 6, 8 and 5). There were small average increased yields of grain and straw on Fields A and B from the use of a mixture carrying nitrogen and potash, while on Field C, the unfertilized plats gave a larger yield than this mixture. As an average of all three fields, the increase was 0.2 bushels of grain and 34 pounds of straw. When the cost of the fertilizer is taken into consideration, this application gave an annual loss of $2.84 per acre.

Phosphoric Acid and Potash (PK) (Plats 7, 9, and 12[2]). Phosphoric acid and potash combined gave increased yields on all the plats in the three fields, the average annual increased yield on Field A, being 7.8 bushels of grain and 606 pounds of straw; on Field B, 9.3 bushels of grain and 877 pounds of straw; and on Field C, 5.6 bushels of grain and 436 pounds of straw. On an average of nine years' results for all three fields, an increase was secured of 8.7 bushels of grain and 761 pounds of straw, giving an annual profit,

over the cost of the fertilizer, of $12.39 per acre. This increase is 4 cents more than that received from an application of nitrogen and phosphoric acid, although the average yield from nitrogen and phosphoric acid was more by 1.1 bushels of grain and 120 pounds of straw than from the plats receiving a mixture of phosphoric acid and potash. This difference is caused by difference in cost of the fertilizer applications, it being $4.56 annually per acre on the plats receiving nitrogen and phosphoric acid and $2.16 per acre for the plats receiving a mixture of phosphoric acid and potash. From these results, it is seen that potash added to phosphoric acid has increased the yield by 3.1 bushels of grain and 266 pounds of straw respectively per acre over plats receiving phosphoric acid alone; showing that potash has been effective in the growth of wheat on this soil when used in conjunction with phosphoric acid.

FIG. 2.—SHOWING WHEAT ON LAND (PLAT 15—2ND SERIES, FIELD A) TREATED CONTINUOUSLY WITH A COMPLETE FERTILIZER AND LIME (NPKL)
PHOTO 1923

Nitrogen, Phosphoric Acid and Potash (NPK) (Plats 8, 10, and 6). When all three of the fertilizer materials were applied together as a complete fertilizer, increased yields were obtained on all three fields. The average annual increase over the unfertilized plats for all three fields being 10.3 bushels of grain and 783 pounds of straw per acre, which together were worth $14.33, over the cost of the fertilizer mixture applied. From the standpoint of yield as well as annual net returns, it is evident that it pays to use a complete fertilizer for wheat on this type of soil.

Lime (L) (Plats 14^2, 1, and 7^2). Increased yields were secured of both grain and straw on all three fields during the nine years of the experiment. The average annual increase for the three fields being 2.3 bushels of grain and 289 pounds of straw per acre. After allowing for cost of lime, an annual net profit of $3.70 per acre was secured.

Lime with Complete Fertilizer (NPKL) (Plats 15^2, 2, and 9^2). When lime was used in combination with a complete fertilizer, an increase in yield of wheat and net profit per acre was secured on all three fields. On an average, the increase in yield was 12.3 bushels of grain and 923 pounds of straw, giving a net annual return, over the cost of fertilizer treatment, of $16.83 per acre.

From the results given in Table I, it is shown—

1. That nitrogen used alone on this soil was not profitable.
2. That potash alone made less yields than the untreated plats and was, therefore, used at a loss.
3. That phosphoric acid used alone gave a large increase in yield and net profit, showing that it is the plant-food constituent of first importance required for profitable wheat growing on this soil.
4. That the use of lime alone gave increased yields and its use was profitable.
5. That nitrogen added to the phosphoric acid gave increased yields over what the use of phosphoric acid alone did and was profitable.
6. That potash added to phosphoric acid has given decided increased results over the use of phosphoric acid alone and was profitable.
7. That the use of nitrogen added to phosphoric acid has given larger yields than when potash was added to phosphoric acid, but on account of the difference in the cost of nitrogen and potash, the net returns are greater by 4 cents per acre in the former than in the latter case. It is evident, therefore, that nitrogen is more needed than potash for greater wheat yields, but the quantity of this expensive nitrogen required to be added can be reduced by the growth and turning under of legumes.
8. That when all three of the fertilizing constituents were applied, larger yields of wheat were secured and the net profits greater than with the use of any combination of two of the fertilizing constituents.
9. The use of lime with a complete fertilizer has given larger yields and greater net returns than any other treatment tried.

TABLE II—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Nitrogen in Complete Mixture on Yields

Results from Field A in 1911 1915 and 1919

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Yields in Bushels Grain Per Acre				Yields in Pounds Straw Per Acre				Average Increase in Bushels Wheat Per Acre due to Fertilizer	Average Increase in Pounds Straw Per Acre due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bu. and Straw at $10 per Ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw over Cost of Fertil.
					1911	1915	1919	Ave.	1911	1915	1919	Ave.					
4	Unfertilized ----------O=	------	------	------	0.3	1.2	3.0	1.5	32	88	450	190	-------	-------	-------	-------	-------
9	46.2 Lbs. 13% Blood ----------½N= / 175 Lbs. 16% Acid Phosphate P= / 30 Lbs. 20% Manure Salt ----K=	6 / ------ / ------	------ / 28 / ------	------ / ------ / 6	10.4	10.0	6.7	9.0	875	860	660	798	8.4	706	$16.13	$ 3.60	$ 12.53
8	92.3 Lbs. 13% Blood ----------N= / 175 Lbs. 16% Acid Phosphate P= / 30 Lbs. 20% Manure Salt ----K=	12 / ------ / ------	------ / 28 / ------	------ / ------ / 6	13.8	8.3	10.2	10.8	920	530	990	813	10.0	701	18.51	5.04	13.47
10	184.6 Lbs. 13% Blood ----------2N= / 175 Lbs. 16% Acid Phosphate P= / 30 Lbs. 20% Manure Salt ----K=	24 / ------ / ------	------ / 28 / ------	------ / ------ / 6	12.1	10.8	14.7	12.5	1,075	850	1,500	1,142	12.2	1,069	23.65	7.92	15.73
11	Unfertilized ----------O=	------	------	------	0.2	0.0	0.3	0.2	10	28	120	53	-------	-------	-------	-------	-------
11	Unfertilized ----------O=	------	------	------	0.2	0.0	0.3	0.2	10	28	120	53	-------	-------	-------	-------	-------
12	276.9 Lbs. 13% Blood ----------3N= / 175 Lbs. 16% Acid Phosphate P= / 30 Lbs. 20% Manure Salt ----K=	36 / ------ / ------	------ / 28 / ------	------ / ------ / 6	13.3	11.9	17.7	14.3	1,105	955	1,940	1,333	14.0	1,268	27.34	10.80	16.54
18	Unfertilized ----------O=	------	------	------	0.8	1.2	1.3	1.1	100	80	240	140	-------	-------	-------	-------	-------

TABLE II—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Nitrogen in Complete Mixture on Yields

Results from Field B in 1912, 1916 and 1920

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Yields in Bushels Grain Per Acre				Yields in Pounds Straw Per Acre				Average Increase in Bushels Wheat Per Acre due to Fertilizer	Average Increase in Pounds Straw Per Acre due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bu. and Straw at $10 per Ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw over Cost of Fertil.
					1912	1916	1920	Ave.	1912	1916	1920	Ave.					
5	Unfertilized ---------- O=	------	------	------	1.3	4.7	0.0	2.0	75	350	0.0	142	--------	--------	--------	--------	--------
11	46.2 Lbs. 13% Blood ---- ½N=	6	------	-----	12.1	12.5	10.9	11.8	1,170	880	850	967	10.6	864	$20.22	$ 3.60	$ 16.62
	175 Lbs. 16% Acid Phosphate - P=	------	28	-----													
	30 Lbs. 20% Manure Salt ---- K=	------	------	6													
10	92.3 Lbs. 13% Blood ---- N=	12	------	-----	13.1	13.5	16.9	14.5	1,213	910	985	1,036	13.2	927	24.44	5.04	19.40
	175 Lbs. 16% Acid Phosphate - P=	------	28	-----													
	30 Lbs. 20% Manure Salt ---- K=	------	------	6													
12	184.6 Lbs. 13% Blood ---- 2N=	24	------	-----	18.5	16.4	17.0	17.3	1,790	1,190	1,320	1,433	16.2	1,337	30.99	7.92	23.07
	175 Lbs. 16% Acid Phosphate - P=	------	28	-----													
	30 Lbs. 20% Manure Salt ---- K=	------	------	6													
13	276.9 Lbs. 13% Blood ---- 3N=	36	------	-----	20.4	18.3	18.3	19.0	2,075	1,270	1,475	1,607	18.1	1,517	34.74	10.80	23.94
	175 Lbs. 16% Acid Phosphate - P=	------	28	-----													
	30 Lbs. 20% Manure Salt ---- K=	------	------	6													
14	Unfertilized ---------- O=	------	------	------	0.3	2.2	0.0	0.8	30	220	0.0	83	--------	--------	--------	--------	--------

TABLE II—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Nitrogen in Complete Mixture on Yields

Results from Field C in 1913, 1917 and 1921

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Yields in Bushels Grain Per Acre				Yields in Pounds Straw Per Acre				Average Increase in Bushels Wheat Per Acre due to Fertilizer	Average Increase in Pounds Straw Per Acre due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bu. and Straw at $10 per Ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw over Cost of Fertil.
					1913	1917	1921	Ave.	1913	1917	1921	Ave.					
8	Unfertilized ..... O=	------	------	------	3.3	2.3	0.5	2.0	285	200	90	192	------	------	------	------	------
7	46.2 Lbs. 13% Blood ..... ½N=	6	------	------	13.2	6.5	6.0	8.6	1,150	530	580	753	6.6	561	$12.71	$ 3.60	$ 9.11
	175 Lbs. 16% Acid Phosphate - P=	------	28	------													
	30 Lbs. 20% Manure Salt ..... K=	------	------	6													
6	92.3 Lbs. 13% Blood ..... N=	12	------	------	15.8	7.0	6.2	9.7	1,550	540	650	913	7.7	721	15.16	5.04	10.12
	175 Lbs. 16% Acid Phosphate - P=	------	28	------													
	30 Lbs. 20% Manure Salt ..... K=	------	------	6													
9	184.6 Lbs. 13% Blood ..... 2N=	24	------	------	20.8	7.2	8.7	12.2	2,010	690	880	1,193	10.2	1,001	20.31	7.92	12.39
	175 Lbs. 16% Acid Phosphate - P=	------	28	------													
	30 Lbs. 20% Manure Salt ..... K=	------	------	6													
10	276.9 Lbs. 13% Blood ..... 3N=	36	------	------	23.3	13.0	11.2	15.8	2,420	1,160	1,210	1,597	13.8	1,405	27.73	10.80	16.93
	175 Lbs. 16% Acid Phosphate - P=	------	28	------													
	30 Lbs. 20% Manure Salt ..... K=	------	------	6													

TABLE II—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Nitrogen in Complete Mixture on Yields

Average Results for Nine Years in Fields A, B and C

Plat No.	Fertilizer Application Per Acre		Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Average Yields in Bushels Grain Per Acre for Years 1911 to 1921 Inclusive	Average Yields in Pounds Straw Per Acre for Years 1911 to 1921 Inclusive	Average Increase in Bushels Wheat Per Acre Due to Fertilizer	Average Increase in Pounds Straw Per Acre Due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bushel and Straw at $10 per ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw Over Cost of Fertil.
9-11-7	46.2 Lbs. 13% Blood	½N=	6			9.8	839	8.5	710	$16.35	$ 3.60	$ 12.75
	175 Lbs. 16% Acid Phosphate	P=		28								
	30 Lbs. 20% Manure Salt	K=			6							
8-10-6	92.3 Lbs. 13% Blood	N=	12			11.7	921	10.3	783	19.37	5.04	14.33
	175 Lbs. 16% Acid Phosphate	P=		28								
	30 Lbs. 20% Manure Salt	K=			6							
10-12-9	184.6 Lbs. 13% Blood	2N=	24			14.0	1,256	12.9	1,136	24.98	7.92	17.06
	175 Lbs. 16% Acid Phosphate	P=		28								
	30 Lbs. 20% Manure Salt	K=			6							
(4+11)-(5+14)-8	Unfertilized	O=										
12-13-10	276.9 Lbs. 13% Blood	3N=	36			16.4	1,512	15.3	13.97	29.94	10.80	19.14
	175 Lbs. 16% Acid Phosphate	P=		28								
	30 Lbs. 20% Manure Salt	K=			6							
(11+8)-(5+14)-8	Unfertilized	O=										

EFFECT OF VARYING QUANTITIES OF NITROGEN

The experiments, results from which are given in Table II, were planned to show the effect of varying quantities of nitrogen on the yields of wheat, while keeping the amount of phosphoric acid and potash constant.

On one plat, the nitrogen was reduced to one-half normal quantity, making the application 6 pounds of nitrogen per acre or 1.5 per cent in the mixture. On two of the plats, the nitrogen was increased by two and three times the normal (12 pounds per acre) nitrogen application, making the applications 24 and 36 pounds per acre respectively, or 6 and 9 per cent in the mixture.

FIG 3.—SHOWING GROWTH OF WHEAT ON LAND (PLAT 20—2ND SERIES, FIELD A) TREATED WITH 400 LBS. PER ACRE OF A COMPLETE FERTILIZER (NPK) SINCE 1903. PHOTO 1923

The results on all three fields show very uniformly that when the application was increased from 6 pounds to 12 pounds, 24 pounds, and 36 pounds of nitrogen respectively, the yields of wheat showed a corresponding increase. This increase was enough to give a larger net return, after deducting the cost of the fertilizer, as the size of the nitrogen applications were increased. With the use of 6 pounds of nitrogen, the annual net returns were $12.75; for 12 pounds, $14.33; for 24 pounds, $17.06; and for 36 pounds of nitrogen, $19.14 per acre.

Taking into consideration the data contained in Table I showing that phosphoric acid was the most essential plant food to be added for larger crop yields of wheat, it is quite possible that if more phosphoric acid had been used in the fertilizer mixture with the heavier applications of nitrogen, that larger yields of wheat would have been secured.

TABLE III—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Phosphoric Acid in Complete Mixture on Yields

Results from Field A in 1911, 1915 and 1919

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Yields in Bushels Grain Per Acre				Yields in Pounds Straw Per Acre				Average Increase in Bushels Wheat Per Acre due to Fertilizer	Average Increase in Pounds Straw Per Acre due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bu. and Straw at $10 per Ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw over Cost of Fertil.
					1911	1915	1919	Ave.	1911	1915	1919	Ave.					
11	Unfertilized ---------- O=	------	------	------	0.2	0.0	0.3	0.2	10	28	120	53	--------	--------	--------	--------	--------
13	92.3 Lbs. 13% Blood ---------- N= / 87.5 lbs. 16% Acid Phosphate ½P= / 30 Lbs. 20% Manure Salt ---- K=	12 / ------ / ------	------ / 14 / ------	------ / ------ / 6	6.9	5.9	9.2	7.3	585	395	1,010	663	6.8	585	$13.13	$ 4.20	$ 8.93
18	Unfertilized ---------- O=	------	------	------	0.8	1.2	1.3	1.1	100	80	240	140	--------	--------	--------	--------	--------
4	Unfertilized ---------- O=	------	------	------	0.3	1.2	3.0	1.5	32	88	450	190	--------	--------	--------	--------	--------
8	92.3 Lbs. 13% Blood ---------- N= / 175 Lbs. 16% Acid Phosphate P= / 30 Lbs. 20% Manure Salt ---- K=	12 / ------ / ------	------ / 28 / ------	------ / ------ / 6	13.8	8.3	10.2	10.8	920	530	990	813	10.0	701	18.51	5.04	13.47
11	Unfertilized ---------- O=	------	------	------	0.2	0.0	0.3	0.2	10	28	120	53	--------	--------	--------	--------	--------
11	Unfertilized ---------- O=	------	------	------	0.2	0.0	0.3	0.2	10	28	120	53	--------	--------	--------	--------	--------
14	92.3 Lbs. 13% Blood ---------- N= / 350 Lbs. 16% Acid Phosphate 2P= / 30 Lbs. 20% Manure Salt ---- K=	12 / ------ / ------	------ / 56 / ------	------ / ------ / 6	14.4	10.5	11.8	12.2	1,235	750	1,120	1,035	11.6	945	22.13	6,72	15.41
15	92.3 Lbs. 13% Blood ---------- N= / 525 Lbs. 16% Acid Phosphate 3P= / 30 Lbs. 20% Manure Salt ---- K=	12 / ------ / ------	------ / 84 / ------	------ / ------ / 6	17.8	13.9	11.8	14.5	1,330	1,005	1,090	1,142	13.8	1,039	25.90	8.40	17.50
18	Unfertilized ---------- O=	------	------	------	0.8	1.2	1.3	1.1	100	80	240	140	--------	--------	--------	--------	--------

TABLE III—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Phosphoric Acid in Complete Mixture on Yields

Results from Field B in 1912, 1916 and 1920

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Yields in Bushels Grain Per Acre				Yields in Pounds Straw Per Acre				Average Increase Bushels Wheat Per Acre due to Fertilizer	Average Increase in Pounds Straw Per Acre due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bu. and Straw at $10 per Ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw over Cost of Fertil.
					1912	1916	1920	Ave.	1912	1916	1920	Ave.					
14	Unfertilized ----------O=	------	------	------	0.3	2.2	0.0	0.8	30	220	0.0	83	--------	--------	--------	--------	--------
15	92.3 Lbs. 13% Blood ----------N=	12	------	-----	8.1	13.2	6.0	9.1	715	1,020	320	685	8.3	602	$15.46	$ 4.20	$ 11.26
	87.5 lbs. 16% Acid Phosphate ½P=	------	14	-----													
	30 Lbs. 20% Manure Salt ----K=	------	------	6													
5	Unfertilized ----------O=	------	------	------	1.3	4.7	0.0	2.0	75	350	0.0	142	--------	--------	--------	--------	--------
10	92.3 Lbs. 13% Blood ----------N=	12	------	-----	13.1	13.5	16.9	14.5	1,213	910	985	1,036	13.2	927	24.44	5.04	19.40
	175 Lbs. 16% Acid Phosphate -P=	------	28	-----													
	30 Lbs. 20% Manure Salt ----K=	------	------	6													
14	Unfertilized ----------O=	------	------	------	0.3	2.2	0.0	0.8	30	220	0.0	83	--------	--------	--------	--------	--------
1[2]	92.3 Lbs. 13% Blood ----------N=	12	------	-----	14.8	15.3	18.8	16.3	1,215	1,155	1,260	1,210	15.0	1,092	27.96	6.72	21.24
	350 Lbs. 16% Acid Phosphate 2P=	------	56	-----													
	30 Lbs. 20% Manure Salt ----K=	------	------	6													
2[2]	92.3 Lbs. 13% Blood ----------N=	12	------	-----	13.5	11.7	17.0	14.1	1.190	860	880	977	12.8	859	23.50	8.40	15.10
	525 Lbs. 16% Acid Phosphate 3P=	------	84	-----													
	30 Lbs. 20% Manure Salt ----K=	------	------	6													
5[2]	Unfertilized ----------O=	------	------	------	0.5	3.3	0.0	1.3	70	285	0.0	118	--------	--------	--------	--------	--------

TABLE III—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Phosphoric Acid in Complete Mixture on Yields

Results from Field C in 1913, 1917 and 1921

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Yields in Bushels Grain Per Acres				Yields in Pounds Straw Per Acre				Average Increase in Bushels Wheat Per Acre due to Fertilizer	Average Increase in Pounds Straw Per Acre due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bu. and Straw at $10 per Ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw over Cost of Fertil.
					1913	1917	1921	Ave.	1913	1917	1921	Ave.					
8	Unfertilized ----------O=	------	------	------	3.3	2.3	0.5	2.0	285	200	90	192	------	------	------	------	------
11	92.3 Lbs. 13% Blood ----------N=	12	------	------	12.0	7.0	4.5	7.8	1,130	640	510	760	5.8	568	$11.54	$ 4.20	$ 7.34
	87.5 lbs. 16% Acid Phosphate ½P=	------	14	------													
	30 Lbs. 20% Manure Salt ----K=	------	------	6													
6	92.3 Lbs. 13% Blood ----------N=	12	------	------	15.8	7.0	6.2	9.7	1,550	540	650	913	7.7	721	15.16	5.04	10.12
	175 Lbs. 16% Acid Phosphate -P=	------	28	------													
	30 Lbs. 20% Manure Salt ----K=	------	------	6													
12	92.3 Lbs. 13% Blood ----------N=	12	------	------	18.3	8.5	6.8	11.2	1,620	770	690	1,027	9.2	835	17.98	6.72	11.26
	350 Lbs. 16% Acid Phosphate 2P=	------	56	------													
	30 Lbs. 20% Manure Salt ----K=	------	------	6													
13	92.3 Lbs. 13% Blood ----------N=	12	------	------	20.3	10.0	7.7	12.7	1,720	840	740	1,100	10.7	908	20.59	8.40	12.19
	525 Lbs. 16% Acid Phosphate 3P=	------	84	------													
	30 Lbs. 20% Manure Salt ----K=	------	------	6													

TABLE III—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Phosphoric Acid in Complete Mixture on Yields

Average Results for Nine Years in Fields A, B and C

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Average Yields in Bushels Grain Per Acre for Years 1911 to 1921 Inclusive	Average Yields in Pounds Straw Per Acre for Years 1911 to 1921 Inclusive	Average Increase in Bushels Wheat Per Acre Due to Fertilizer	Average Increase in Pounds Straw Per Acre Due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bushel and Straw at $10 per ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw Over Cost of Fertil.
1+18)-14-8	Unfertilized ..... O=										
13-15-11	92.3 Lbs. 13% Blood ..... N=	12			8.1	703	7.0	585	$13.38	$ 4.20	$ 9.18
	87.5 Lbs. 16% Acid Phosphate ..... ½P=		14								
	30 Lbs. 20% Manure Salt ..... K=			6							
(4+11)-(5+14)-8	Unfertilized ..... O=										
8-10-6	92.3 Lbs. 13% Blood ..... N=	12			11.7	921	10.3	783	19.37	5.04	14.33
	175 Lbs. 16% Acid Phosphate ..... P=		28								
	30 Lbs. 20% Manure Salt ..... K=			6							
(11+18)-5²-8	Unfertilized ..... O=										
14-1²-12	92.3 Lbs. 13% Blood ..... N=	12			13.2	1,091	11.9	957	22.69	6.72	15.97
	350 Lbs. 16% Acid Phosphate ..... 2P=		56								
	30 Lbs. 20% Manure Salt ..... K=			6							
15-2²-13	92.3 Lbs. 13% Blood ..... N=	12			13.8	1,073	12.4	935	23.33	8.40	14.93
	525 Lbs. 16% Acid Phosphate ..... 3P=		84								
	30 Lbs. 20% Manure Salt ..... K=			6							

EFFECT OF VARYING QUANTITIES OF PHOSPHORIC ACID

The experiments, results of which are given in Table III, were planned to show the effect on the yields of wheat of varying quantities of phosphoric acid; the quantities of nitrogen and potash applied remaining constant. To carry this out, on one plat one-half the normal quantity of phosphoric acid was applied, making the application 14 pounds of phosphoric acid per acre or 3.5 per cent in the mixture. On two of the plats, the phosphoric acid was increased by two and three times the normal (28 pounds per acre) application, making the application, therefore, 56 and 84 pounds of phosphoric acid per acre, respectively, or 14 and 21 per cent in the fertilizer mixture.

FIG. 4.—SHOWING WHEAT ON EXPERIMENTAL FIELD (PLAT 15—1ST SERIES, FIELD A) TO WHICH A COMPLETE FERTILIZER HIGH IN PHOSPHORIC ACID (NP_3K) HAS BEEN APPLIED CONTINUOUSLY SINCE 1903. PHOTO 1923

With the exception of plat 2^2 on Field B, which received an application of 84 pounds of phosphoric acid to the acre, the results on all three fields uniformly show increased yields of wheat as the phosphoric acid application was increased. An average of nine years experiments on the three fields show that the largest profit was obtained from an application of 56 pounds of phosphoric acid per acre. As the profit on this plat is only $1.64 more than the profit from the plats receiving 28 pounds of phosphoric acid per acre, it is probable that unless the nitrogen application is increased the most profitable amount of phosphoric acid to use would be around 42 pounds per acre.

TABLE IV—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Potash in Complete Mixture on Yields

Results from Field A in 1911, 1915 and 1919

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Yields in Bushels Grain Per Acre				Yields in Pounds Straw Per Acre				Average Increase in Bushels Wheat Per Acre due to Fertilizer	Average Increase in Pounds Straw Per Acre due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bu. and Straw at $10 per Ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw over Cost of Fertil.
					1911	1915	1919	Ave.	1911	1915	1919	Ave.					
11	Unfertilized ---------- O=	------	------	------	0.2	0.0	0.3	0.2	10	28	120	53	--------	--------	--------	--------	--------
16	92.3 Lbs. 13% Blood ---------- N=	12	------	-----	11.1	9.4	7.7	9.4	785	685	760	743	8.6	628	$16.04	$ 4.80	$ 11.24
	175 Lbs. 16% Acid Phosphate - P=	------	28	-----													
	15 Lbs. 20% Manure Salt - ½K=	------	------	3													
18	Unfertilized ---------- O=	------	------	------	0.8	1.2	1.3	1.1	100	80	240	140	--------	--------	--------	--------	--------
4	Unfertilized ---------- O=	------	------	------	0.3	1.2	3.0	1.5	32	88	450	190	--------	--------	--------	--------	--------
8	92.3 Lbs. 13% Blood ---------- N=	12	------	-----	13.8	8.3	10.2	10.8	920	530	990	813	10.0	701	18.51	5.04	13.47
	175 Lbs. 16% Acid Phosphate - P=	------	28	-----													
	30 Lbs. 20% Manure Salt ---- K=	------	------	6													
11	Unfertilized ---------- O=	------	------	------	0.2	0.0	0.3	0.2	10	28	120	53	--------	--------	--------	--------	--------
11	Unfertilized ---------- O=	------	------	------	0.2	0.0	0.3	0.2	10	28	120	53	--------	--------	--------	--------	--------
17	92.3 Lbs. 13% Blood ---------- N=	12	------	-----	12.6	10.3	7.8	10.2	995	715	670	793	9.2	665	17.13	5.52	11.61
	175 Lbs. 16% Acid Phosphate - P=	------	28	-----													
	60 Lbs. 20% Manure Salt ---- 2K=	------	------	12													
18	Unfertilized ---------- O=	------	------	------	0.8	1.2	1.3	1.1	100	80	240	140	--------	--------	--------	--------	--------
18	Unfertilized ---------- O=	------	------	------	0.8	1.2	1.3	1.1	100	80	240	140	--------	--------	--------	--------	--------
19	92.3 Lbs. 13% Blood ---------- N=	12	------	-----	12.1	13.9	15.3	13.8	925	955	1,490	1,123	12.7	983	23.97	6.00	17.97
	175 Lbs. 16% Acid Phosphate - P=	------	28	-----													
	90 Lbs. 20% Manure Salt ---- 3K=	------	------	18													

TABLE IV—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Potash in Complete Mixture on Yields

Results from Field B in 1912, 1916 and 1920

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Yields in Bushels Grain Per Acre				Yields in Pounds Straw Per Acre				Average Increase in Bushels Wheat Per Acre due to Fertilizer	Average Increase in Pounds Straw Per Acre due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bu. and Straw at $10 per Ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw over Cost of Fertil.
					1912	1916	1920	Ave.	1912	1916	1920	Ave.					
3[2]	92.3 Lbs. 13% Blood N= / 175 Lbs. 16% Acid Phosphate P= / 15 Lbs. 20% Manure Salt ½K=	12	28	3	10.6	10.3	11.3	10.7	965	755	480	733	9.4	615	$17.18	$ 4.80	$ 13.38
5[2]	Unfertilized O=				0.5	3.3	0.0	1.3	70	285	0.0	118					
5	Unfertilized O=				1.3	4.7	0.0	2.0	75	350	0.0	142					
10	92.3 Lbs. 13% Blood N= / 175 Lbs. 16% Acid Phosphate P= / 30 Lbs. 20% Manure Salt K=	12	28	6	13.1	13.5	16.9	14.5	1,213	910	985	1,036	13.2	927	24.44	5.04	19.40
14	Unfertilized O=				0.3	2.2	0.0	0.8	30	220	0.0	83					
4[2]	92.3 Lbs. 13% Blood N= / 175 Lbs. 16% Acid Phosphate P= / 60 Lbs. 20% Manure Salt 2K=	12	28	12	11.6	10.3	8.6	10.2	1,005	710	745	820	8.9	702	16.86	5.52	11.34
5[2]	Unfertilized O=				0.5	3.3	0.0	1.3	70	285	0.0	118					
5[2]	Unfertilized O=				0.5	3.3	0.0	1.3	70	285	0.0	118					
6[2]	92.3 Lbs. 13% Blood N= / 175 Lbs. 16% Acid Phosphate P= / 90 Lbs. 20% Manure Salt 3K=	12	28	18	10.5	10.3	9.5	10.1	770	695	550	672	8.9	464	15.67	6.00	9.67
14[2]	Unfertilized O=				0.0	0.4	0.0	0.1	0.0	50	0.0	17					

TABLE IV—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Potash in Complete Mixture on Yields

Results from Field C in 1913, 1917 and 1921

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Yields in Bushels Grain Per Acre				Yields in Pounds Straw Per Acre				Average Increase in Bushels Wheat Per Acre due to Fertilizer	Average Increase in Pounds Straw Per Acre due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bu. and Straw at $10 per Ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw over Cost of Fertil.
					1913	1917	1921	Ave.	1913	1917	1921	Ave.					
8	Unfertilized ---------- O=	------	------	------	3.3	2.3	0.5	2.0	285	200	90	192	------	------	------	------	------
14	92.3 Lbs. 13% Blood ---------- N=	12	------	-----	13.0	7.2	5.5	8.6	1,150	550	590	763	6.6	571	$12.76	$ 4.80	$ 7.96
	175 Lbs. 16% Acid Phosphate - P=	------	28	-----													
	15 Lbs. 20% Manure Salt - ½K=	------	------	3													
6	92.3 Lbs. 13% Blood ---------- N=	12	------	-----	15.8	7.0	6.2	9.7	1,550	540	650	913	7.7	721	15.16	5.04	10.12
	175 Lbs. 16% Acid Phosphate - P=	------	28	-----													
	30 Lbs. 20% Manure Salt ---- K=	------	------	6													
15	92.3 Lbs. 13% Blood ---------- N=	12	------	-----	14.3	6.5	4.8	8.5	1,280	530	510	773	6.5	581	12.66	5.52	7.14
	175 Lbs. 16% Acid Phosphate - P=	------	28	-----													
	60 Lbs. 20% Manure Salt ---- 2K=	------	------	12													
16	92.3 Lbs. 13% Blood ---------- N=	12	------	-----	15.3	6.2	5.5	9.0	1,340	490	560	797	7.0	605	13.53	6.00	7.53
	175 Lbs. 16% Acid Phosphate - P=	------	28	-----													
	90 Lbs. 20% Manure Salt ---- 3K=	------	------	18													

TABLE IV—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Potash in Complete Mixture on Yields

Average Results for Nine Years in Fields A, B and C

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Average Yields in Bushels Wheat Per Acre for Years 1911 to 1921 Inclusive	Average Yields in Pounds Straw Per Acre for Years 1911 to 1921 Inclusive	Average Increase in Bushels Wheat Per Acre Due to Fertilizer	Average Increase in Pounds Straw Per Acre Due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bushel and Straw at $10 per ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw Over Cost of Fertil.
(11+18)-5²-8	Unfertilized ---- O=										
16-3²-14	92.3 Lbs. 13% Blood ---- N=	12			9.6	746	8.2	605	$15.33	$ 4.80	$ 10.53
	175 Lbs. 16% Acid Phosphate ---- P=		28								
	15 Lbs. 20% Manure Salt ---- ½K=			3							
(4+11)-(5+14)-8	Unfertilized ---- O=										
8-10-6	92.3 Lbs. 13% Blood ---- N=	12			11.7	921	10.3	783	19.37	5.04	14.33
	175 Lbs. 16% Acid Phosphate ---- P=		28								
	30 Lbs. 20% Manure Salt ---- K=			6							
(11+18)-5²-8	Unfertilized ---- O=										
17-4²-15	92.3 Lbs. 13% Blood ---- N=	12			9.6	795	8.2	649	15.55	5.52	10.03
	175 Lbs. 16% Acid Phosphate ---- P=		28								
	60 Lbs. 20% Manure Salt ---- 2K=			12							
18-(5²+14²)-8	Unfertilized ---- O=										
19-6²-8	92.3 Lbs. 13% Blood ---- N=	12			11.0	864	9.5	684	17.72	6.00	11.72
	175 Lbs. 16% Acid Phosphate ---- P=		28								
	90 Lbs. 20% Manure Salt ---- 3K=			18							

EFFECT OF VARYING QUANTITIES OF POTASH

The experiments, results of which are given in Table IV, were planned to show the effect on the yield of wheat of varying quantities of potash, the quantities of nitrogen and phosphoric acid used remaining constant. In carrying this out, on one plat one-half the normal quantity of potash, making the application 3 pounds of potash or 0.75 per cent in the fertilizer mixture, was used. On two plats, the potash was increased by two and three times the normal (6 pounds per acre) application, making the applications 12 and 18 pounds of potash, respectively, or three and six per cent in the fertilizer mixture.

With the exception of plat 19 on Field A, which gave the largest yield of wheat and net returns per acre, the results are uniform in showing that an application of 6 pounds of potash is more profitable to use than either the use of 3, 12, or 18 pounds of potash per acre. In most cases, the use of three pounds per acre gave larger net returns than did the use of 12 and 18 pounds per acre.

The indications are very strong that 1.5 per cent potash is all that is needed for wheat on this type of soil, when it is used with the regular quantity of nitrogen and phosphoric acid contained in the normal fertilizer mixture.

The results throw further light on the comparative value of nitrogen and potash for growing wheat on this soil and give unquestionably a more important place to nitrogen than to potash.

TABLE V—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Complete Fertilizer on Yields

Results from Field A in 1911, 1915 and 1919

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Yields in Bushels Grain Per Acre				Yields in Pounds Straw Per Acre				Average Increase in Bushels Wheat Per Acre due to Fertilizer	Average Increase in Pounds Straw Per Acre due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bu. and Straw at $10 per Ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw over Cost of Fertil.
					1911	1915	1919	Ave.	1911	1915	1919	Ave.					
18	Unfertilized ..... O=	------	------	------	0.8	1.2	1.3	1.1	100	80	240	140	--------	--------	--------	--------	--------
20	46.2 Lbs. 13% Blood ..... ½N=	6	------	-----	7.4	9.3	9.2	8.6	605	795	920	773	7.5	633	$14.42	$ 2.52	$ 11.90
	87.5 lbs. 16% Acid Phosphate ½P=	------	14	-----													
	15 Lbs. 20% Manure Salt ... ½K=	------	------	3													
4	Unfertilized ..... O=	------	------	------	0.3	1.2	3.0	1.5	32	88	450	190	--------	--------	--------	--------	--------
8	92.3 Lbs. 13% Blood ..... N=	12	------	-----	13.8	8.3	10.2	10.8	920	530	990	813	10.0	701	18.51	5.04	13.47
	175 Lbs. 16% Acid Phosphate . P=	------	28	-----													
	30 Lbs. 20% Manure Salt ..... K=	------	------	6													
11	Unfertilized ..... O=	------	------	------	0.2	0.0	0.3	0.2	10	28	120	53	--------	--------	--------	--------	--------
4[2]	Unfertilized ..... O=	------	------	------	0.3	0.0	1.3	0.5	20	28	230	93	--------	--------	--------	--------	--------
1[2]	138.5 Lbs. 13% Blood ..... 1½N=	18	------	-----	17.8	14.8	10.3	14.3	880	1,065	980	975	13.8	882	25.11	7.56	17.55
	262.5 Lbs. 16% Acid Phosphate 1½P=	------	42	-----													
	45 Lbs. 20% Manure Salt .. 1½K=	------	------	9													
2[2]	184.6 Lbs. 13% Blood ..... 2N=	24	------	-----	17.6	15.4	13.3	15.4	1,945	1,065	1,320	1,443	14.9	1,350	29.10	10.08	19.02
	350 Lbs. 16% Acid Phosphate 2P=	------	56	-----													
	60 Lbs. 20% Manure Salt .... 2K=	------	------	12													
3[2]	230.8 Lbs. 13% Blood ..... 2½N=	30	------	-----	19.3	16.8	15.3	17.1	1,440	1,160	1,480	1,360	16.6	1,267	31.24	12.60	18.64
	437.5 Lbs. 16% Acid Phosphate 2½P=	------	70	-----													
	75 Lbs. 20% Manure Salt .. 2½K=	------	------	15													

TABLE V—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Complete Fertilizer on Yields

Results from Field B in 1912, 1916, ank 1920

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Yields in Bushels Grain Per Acre				Yields in Pounds Straw Per Acre				Average Increase in Bushels Wheat Per Acre due to Fertilizer	Average Increase in Pounds Straw Per Acre due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bu. and Straw at $10 per Ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw over Cost of Fertil.
					1912	1916	1920	Ave.	1912	1916	1920	Ave.					
5[2]	Unfertilized ----------O=	-----	-----	-----	0.5	3.3	0.0	1.3	70	285	0.0	118	-------	-------	-------	-------	-------
7[2]	46.2 Lbs. 13% Blood ----------½N=	6	-----	-----	0.0												
	87.5 lbs. 16% Acid Phosphate ½P=	-----	14	-----	5.8	8.1	1.7	5.2	555	555	340	483	4.2	387	$ 8.24	$ 2.52	$ 5.72
	15 Lbs. 20% Manure Salt ----½K=	-----	-----	3													
14[2]	Unfertilized ----------O=	-----	-----	-----	0.0	0.4	0.0	0.1	0.0	50	0.0	17	-------	-------	-------	-------	-------
5	Unfertilized ----------O=	-----	-----	-----	1.3	4.7	0.0	2.0	75	350	0.0	142	-------	-------	-------	-------	-------
10	92.3 Lbs. 13% Blood ----------N=	12	-----	-----	13.1	13.5	16.9	14.5	1,213	910	985	1,036	13.2	927	24.44	5.04	19.40
	175 Lbs. 16% Acid Phosphate -P=	-----	28	-----													
	30 Lbs. 20% Manure Salt ----K=	-----	-----	6													
14	Unfertilized ----------O=	-----	-----	-----	0.3	2.2	0.0	0.8	30	22	0.0	83	-------	-------	-------	-------	-------
5[2]	Unfertilized ----------O=	-----	-----	-----	0.5	3.3	0.0	1.3	70	285	0.0	118	-------	-------	-------	-------	-------
8[2]	138.5 Lbs. 13% Blood ----1½N=	18	-----	-----	18.4	14.7	15.3	16.1	1,695	1,030	880	1,202	15.2	1,118	28.39	7.56	20.83
	262.5 Lbs. 16% Acid Phosphate 1½P=	-----	42	-----													
	45 Lbs. 20% Manure Salt --1½K=	-----	-----	9													
9[2]	184.6 Lbs. 13% Blood ----------2N=	24	-----	-----	17.2	13.6	16.3	15.7	1,570	945	1,120	1,212	14.9	1,139	28.05	10.08	17.97
	350 Lbs. 16% Acid Phosphate 2P=	-----	56	-----													
	60 Lbs. 20% Manure Salt ----2K=	-----	-----	12													
10[2]	230.8 Lbs. 13% Blood ----2½N=	30	-----	-----	23.9	13.5	22.2	19.9	1,815	960	1,440	1,405	19.3	1,343	35.67	12.60	23.07
	437.5 Lbs. 16% Acid Phosphate 2½P=	-----	70	-----													
	75 Lbs. 20% Manure Salt -2½K=	-----	-----	15													
14[2]	Unfertilized ----------O=	-----	-----	-----	0.0	0.4	0.0	0.1	0.0	50	0.0	17	-------	-------	-------	-------	-------

TABLE V—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Complete Fertilizer on Yields

Results from Field C in 1913, 1917 and 1921

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Yields in Bushels Grain Per Acre				Yields in Pounds Straw Per Acre				Average Increase in Bushels Wheat Per Acre due to Fertilizer	Average Increase in Pounds Straw Per Acre due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bu. and Straw at $10 per Ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw over Cost of Fertil.
					1913	1917	1921	Ave.	1913	1917	1921	Ave.					
1[2]	46.2 Lbs. 13% Blood ½N= / 87.5 Lbs. 16% Acid Phosphate ½P= / 15 Lbs. 20% Manure Salt ½K=	6	14	3	4.7	1.0	1.5	2.4	400	120	170	230	1.3	113	$ 2.52	$ 2.52	$ 0.00
8[2]	Unfertilized O=				2.5	0.7	0.2	1.1	220	80	50	117					
6	92.3 Lbs. 13% Blood N= / 175 Lbs. 16% Acid Phosphate P= / 30 Lbs. 20% Manure Salt K=	12	28	6	15.8	7.0	6.2	9.7	1,550	540	650	913	7.7	721	15.16	5.04	10.12
8	Unfertilized O=				3.3	2.3	0.5	2.0	285	200	90	192					
2[2]	138.5 Lbs. 13% Blood 1½N= / 262.5 Lbs. 16% Acid Phosphate 1½P= / 45 Lbs. 20% Manure Salt 1½K=	18	42	9	14.3	4.7	7.7	8.9	1,440	420	770	877	7.8	760	15.50	7.56	7.94
3[2]	184.6 Lbs. 13% Blood 2N= / 350 Lbs. 16% Acid Phosphate 2P= / 60 Lbs. 20% Manure Salt 2K=	24	56	12	20.0	10.8	11.0	13.9	2,000	890	1,040	1,310	12.8	1,193	25.17	10.08	15.09
4[2]	230.8 Lbs. 13% Blood 2½N= / 437.5 Lbs. 16% Acid Phosphate 2½P= / 75 Lbs. 20% Manure Salt 2½K=	30	70	15	21.3	12.7	11.0	15.0	2,060	1,040	1.060	1,387	13.9	1,270	27.20	12.60	14.60
8[2]	Unfertilized O=				2.5	0.7	0.2	1.1	220	80	50	117					

TABLE V—Results of Fertilizer Experiments With Wheat at Iredell Farm, Showing Effect of Varying Quantities of Complete Fertilizer on Yields

Average Results for Nine Years in Fields A, B and C

Plat No.	Fertilizer Application Per Acre	Pounds Nitrogen (N) Per Acre	Pounds Phos. Acid (P_2O_5) Per Acre	Pounds Potash (K_2O) Per Acre	Average Yields in Bushels Grain Per Acre for Years 1911 to 1921 Inclusive	Average Yields in Pounds Straw Per Acre for Years 1911 to 1921 Inclusive	Average Increase in Bushels Grain Per Acre Due to Fertilizer	Average Increase in Pounds Straw Per Acre Due to Fertilizer	Value of Increase with Wheat at $1.50 Per Bushel and Straw at $10 per ton	Cost of Fertilizer Per Acre	Value of Average Annual Increase of Wheat and Straw Over Cost of Fertil.
$18-(5^2+14^2)-8^2$	Unfertilized ..... O=										
$20-7^2-1^2$	46.2 Lbs. 13% Blood ..... ½N=	6			5.4	495	4.3	378	$ 8.39	$ 2.52	$ 5.87
	87.5 Lbs. 16% Acid Phosphate ..... ½P=		14								
	15 Lbs. 20% Manure Salt ..... ½K=			3							
(4+11)-(5+14)-8	Unfertilized ..... O=										
8-10-6	92.3 Lbs. 13% Blood ..... N=	12			11.7	921	10.3	783	19.37	5.04	14.33
	175 Lbs. 16% Acid Phosphate ..... P=		28								
	30 Lbs. 20% Manure Salt ..... K=			6							
$4^2-(5^2+14^2)-8^2$	Unfertilized ..... O=										
$1^2-8^2-2^2$	138.5 Lbs. 13% Blood ..... 1½N=	18			13.1	1,018	12.3	920	23.00	7.56	15.44
	262.5 Lbs. 16% Acid Phosphate ..... 1½P=		42								
	45 Lbs. 20% Manure Salt ..... 1½K=			9							
$2^2-9^2-3^2$	184.6 Lbs. 13% Blood ..... 2N=	24			15.0	1,322	14.2	1,227	27.44	10.08	17.36
	350 Lbs. 16% Acid Phosphate ..... 2P=		56								
	60 Lbs. 20% Manure Salt ..... 2K=			12							
$3^2-10^2-4^2$	230.8 Lbs. 13% Blood ..... 2½N=	30			17.3	1,384	16.6	1,293	31.37	12.60	18.77
	437.5 Lbs. 16% Acid Phosphate ..... 2½P=		70								
	75 Lbs. 20% Manure Salt ..... 2½K=			15							

EFFECT OF VARYING QUANTITIES OF FERTILIZER

The experiments, results of which are given in Table V, were designed to show the effect on the yield of wheat of decreasing and increasing the normal (NPK) fertilizer application, which consists of 400 pounds per acre of a mixture containing 7 per cent available phosphoric acid, 3 per cent nitrogen, and 1.5 per cent potash. The applications were made at the rate of 200 ½(NPK) pounds; 400 (NPK) pounds; 600 1½(NPK) pounds; 800 2(NPK) pounds; and 1,000 2½(NPK) pounds per acre, broadcast at seeding.

FIG. 5.—WHEAT ON LAND (PLAT 3—2ND SERIES, FIELD A) TO WHICH 1,000 LBS. PER ACRE OF COMPLETE FERTILIZER (2½ NPK) HAS BEEN APPLIED
PHOTO 1923

The average results for the nine years show increased yields and profits for all the quantities of fertilizer used, 1,000 pounds giving the largest net returns. For Fields A and C, the largest net returns were secured from the use of 800 pounds per acre; while for Field B, the use of a 1,000 pounds of fertilizer produced the greatest profit.

Concisely, the average results with the different quantities of fertilizers were as follows:

Fertilizer Per Acre—Pounds	Average Yield Per Acre		Average Increase Over Unfertilized Plats Per Acre		Average Value of Increase Over Cost of Fertilizer
	Grain Bushels	Straw Pounds	Grain Bushels	Straw Pounds	
200	5.4	495	4.3	378	$ 5.87
400	11.7	921	10.3	783	14.33
600	13.1	1,018	12.3	920	15.44
800	15.0	1,322	14.2	1,227	17.36
1,000	17.3	1,384	16.6	1,293	18.77

II. WHEAT CULTURE IN PIEDMONT NORTH CAROLINA

Wheat is most important in the Piedmont and Mountain regions of the State. There are a few soils, however, in the Eastern portion of the State on which this crop can be grown fairly successfully, such soils being those that are well drained and are of a clayey, sandy clay or loamy nature, underlaid by clay or sandy clay subsoils. The importance of the wheat crop of the State may be appreciated by recalling that the 1919 crop was valued at almost seven million dollars.

Wheat need not be an expensive crop to produce as it is put in during the fall after a crop of corn or some summer-growing legume like cowpeas or soybeans, and is removed in time the following spring for the land to go again into cowpeas, soybeans, or corn in some cases. The writers are fully convinced, however, that in many cases in normal times wheat would be far more profitable harvested for hay than for grain. The objection raised to the growth of wheat on many farms is that the harvesting and threshing of it comes at a time of the year when many general farmers can ill afford to spare their time and teams from planting and cultivating their other crops. It is under such circumstances as this that farmers might seriously consider the advisability of converting their wheat crop into hay. They would be able to get their land for other crops at least ten days to two weeks earlier than they could were they to allow the wheat to stand, mature the grain and then have to thresh the crop from the field.

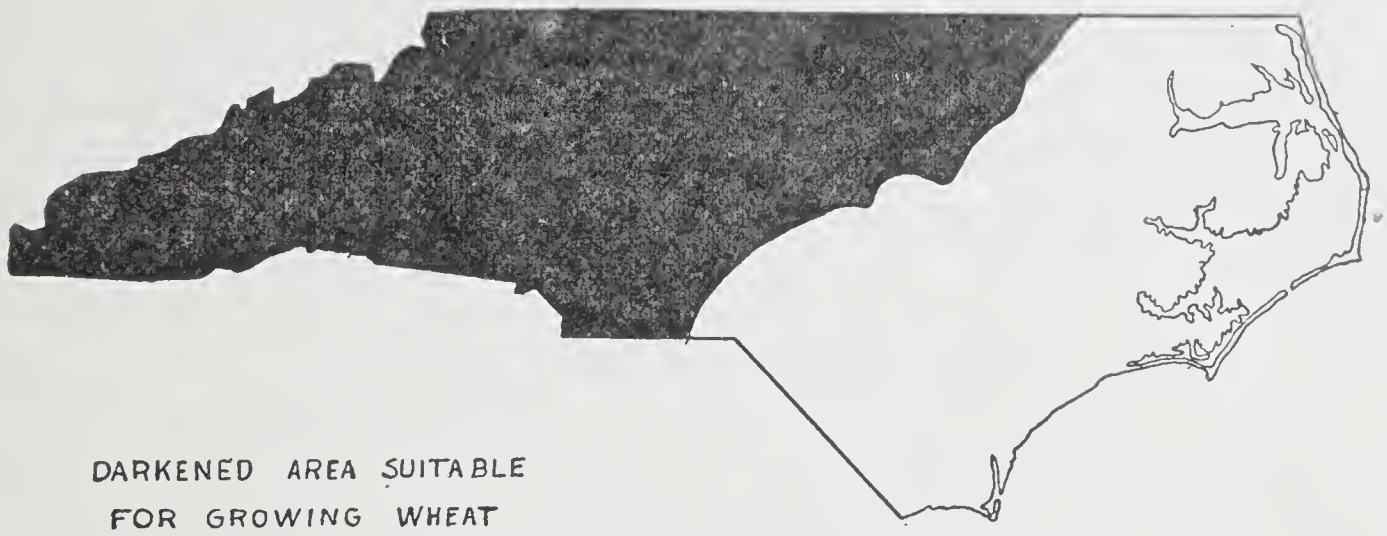
WHEAT EXHAUSTS THE SOIL SOME

It should be remembered that wheat, when both grain and straw are removed from the land, will exhaust considerable of the reserve fertility of the farm. It will, this season, require an expenditure for plant food in mixed fertilizers of about 27 cents for each bushel of wheat produced and removed. Again, for every ton of straw removed from the land it would cost $2.76 to replace the fertilizing constituents carried away. All or most of these fertilizing constituents must be returned to the soil, if the soil is to be maintained in a productive state.

SOIL AND ITS PREPARATION

Although wheat will grow in a diversity of soils, it does best on the rather close heavy soils of the clayey or loamy types. The light clay soils, having the proper degree of compactness and organic matter, are more retentive of moisture and plant food and are generally better adapted for wheat growing than are the loams. Alluvial soils, when not too rich, usually prove good wheat lands, as they are deep

and fertile and contain clay, sand and humas mixed in the proper proportions to render them friable and porous, and easily drained. For spring sowing the loams are well suited. The light sandy soils of the Coastal Plain region of the State are not generally well suited for the culture of this crop. Soils which are wet, peaty or sour in their nature are not at all suited for wheat growing. Good drainage of the soil and subsoil are essential with any type of soil. The nature of the soil influences the yield to a much greater extent than it does the quality of the grain which is governed to a large degree by climatic conditions. Land intended for wheat should be plowed or disked as early as possible after the removal of the previous crop—at least three or four weeks before seeding time—in order to allow the land ample time to settle and to facilitate a conservation of the



DARKENED AREA SUITABLE
FOR GROWING WHEAT

moisture content of the soil. Before the seed are put in, the soil should be thoroughly pulverized to a depth of three or four inches in order to bring about the most favorable conditions for the germination of the seed, and the growth and development of the young plants. In many cases, this condition can be brought about by means of a disk and smoothing harrow. Where necessary to use the plow, as in the case of excessive weed or grass growth, the breaking should not be done to a greater depth than about 6 inches, and should be done early enough in the season to allow the weeds and grass to rot and the soil to settle. If the growth is too heavy to be turned under well, it may be best to cut them with a mowing machine, allowing them to thoroughly dry out before attempting to turn the soil with a plow. When the land is plowed it will be well to disk and harrow it soon afterwards in order to facilitate the settling and compacting of the soil. This may be repeated if necessary to keep down the grass and weeds that may germinate up to the time of seeding.

In some cases for soil moisture conservation, wheat grown in the Northwestern States is given a light harrowing in the spring, but in the Eastern States all the work is generally given to the soil before the crop is put in. Even here, however, during the dry season, the

use of a light harrow or weeder in the spring will frequently prove of benefit. If the land is too open and loose, rolling or planking will prove beneficial after plowing and before seeding, especially so if the fall is dry. This will crush the clods and lumps and compact the soil.

FERTILIZATION

As the removal of the straw and grain from the field makes wheat an exhaustive crop, on the soils of the older States of the South like North Carolina, commercial fertilizer and barnyard manure are being more generously applied to this cereal or to the crops in rotation with it, than possibly in any other portion of the country. The best fertilization for wheat will depend upon the character of the soil, the kind of crops that have been grown on the land prior to the wheat, and the treatment which has been accorded these. To get the most out of any fertilizer or manure it should be applied in a finely divided condition and should be intimately mixed in the surface inch or two of soil, so that the delicate and rather superficial root-system of the young plants may get at it, for if buried deep the roots would not be able to get the necessary plant-food required to make a good growth of the plants. With most of our soils, especially the older ones, used for wheat growing, humus and phosphoric acid and nitrogen to a less extent, are most needed. Without a good supply of humus, commercial fertilizers do not produce their maximum value. Potash seems to be less often required with most of our soils. Under certain conditions green-manuring with leguminous crops is desirable, but if the growth of these is heavy, it will be found best to have another crop come in between, but if the green crops are light they should not be plowed under immediately before sowing to wheat.

Wheat is usually greatly benefited by applications of stable manure or by plowing under the stubble of such crops as cowpeas, soybeans or red clover. In cases where moderately large quantities of manure is to be used it will be better practice to apply only small amounts before seeding and reserve the greater portion to be applied broadcast during the late fall or early winter. Very large applications of nitrogenous materials either in the form of barnyard manure or commercial fertilizing materials should be guarded against, as they will tend to promote the production of an excessive growth of straw which will show a tendency to lodge.

For soils that have become sour, applications of ground limestone, at the rate of 2,000 to 3,000 pounds per acre, will prove beneficial. The lime should be applied, when practical to do so, two to four weeks in advance of seeding and should be thoroughly worked into the soil. A large vigorous growth of stalks and leaves of a dark green color is a good sign that nitrogen is not necessary to be added, but if the plants are small and of a pale green color, if the physical

condition of the soil is good, nitrogen is indicated to be necessary in the fertilizing application. On the average wheat soils of the Piedmont section of the State, that have been well prepared for wheat, the use of something like 600 pounds per acre at the time of seeding of a fertilizing mixture analyzing 10 to 12 per cent available phosphoric acid, and about 3 per cent nitrogen, and 1 per cent potash at seeding should be found to give profitable returns where good seed are used and sown at the proper time. Should the plants in the spring just at the time they are beginning to send up stems for the formation of seed heads not be making satisfactory growth, a side-dressing of 75 to 100 pounds per acre of either nitrate of soda or sulphate of ammonia will usually prove beneficial, especially so where the land is poor or about the average and the percentage of nitrogen in the mixture is not more than 3 per cent. Wheat, if selling at a satisfactory price, should usually pay fairly well for liberal applications of fertilizers if the land has been put in good condition before planting, good seed being used and planted properly. As a rule, however, fertilizers properly used, generally prove more profitable with this crop planted on clay soils than when grown on sandy and sandy loams.

VARIETIES TO SEED

There is no best variety for all sections of the country, but for each locality there are varieties which outyield all others. However, a best-yielding variety in one section of the country may be a poor yielder in another. Some high yielders will likely not prove profitable because of the inferior milling and baking qualities of their grain; while others possess these good characteristics but are poor yielders. It is fortunate, however, that all these qualities may be combined in the same varieties to a considerable degree. As a general thing, the white grain wheats are inferior in quality. Gains secured though the use of seed of the better varieties are the cheapest the farmer can secure, but before making any great investment in seed of a new variety, he should know for certain that it is better than the one he is already growing. Some of the leading varieties are for North Carolina: Leap's Prolific, Purple Straw and Fulcaster.

SELECTING SEED

With different varieties and strains in the same variety there are marked differences in hardiness, resistance to drought, lodging and insect ravages, quality of grain and productiveness. This being so, great opportunities are presented in almost every field for making the variety of wheat being grown on any farm not only more productive, but also more desirable in other respects such as in special qualities for special purposes by intelligent field selection of seed in

the field, just before harvesting, from the most prolific plants. The good qualities of any type of plant may be fixed by careful and systematic selection of seed. Most of the varieties grown at the present time are the result of the selection of seed from individual plants produced by accidental crosses in the general crop.

By the use of seed of the better varieties, the yields in many cases may be increased two to four or more bushels per acre; and then the selection of seed in the field from the most productive stalks will result in a still further increased production per acre. As experiments have demonstrated that the use for planting of the larger, plumper seed of any variety will generally produce larger yields per acre than the average seed secured in the usual way, the grading of the seed by the use of a fanning mill will usually be found to be wise.

TREAT THE SEED FOR SMUT

Considerable wheat is damaged each year by smut. Much of this could be prevented by treating the seed just before the time of planting. A good solution for treating wheat may be made by mixing one pound of formalin with 40 gallons of water. The formalin is a liquid which may be secured from any drug store. In order to treat the seed, the wheat is piled on a clean floor or sheet and sprinkled with the solution of water and formalin. The seed are sprinkled and stirred repeatedly until all of the grains are wet with the solution. The pile is then covered with sacks and left for two or three hours. After this treatment the seed are spread out to dry.

SEEDING WHEAT ON WEEDY LAND

Where one has a piece of land that is covered with a dense growth of weeds in the summer, it will be necessary during the late summer or early fall to cut these weeds, allow them to dry and then turn them into the soil three to four weeks before planting time in order that the land may be put in proper condition when seeding time comes around. If the turning of the weeds is delayed too long, they are liable to cause the land to be too open for best results with wheat. If the growth of weeds is small or moderate in amount, it will not be necessary to cut the weeds with a mower or some other suitable implement before turning the land. However, if the growth is heavy it will be, generally speaking, absolutely necessary to do this in order to get the land in good shape for the proper seeding of the wheat.

Where a heavy growth of green weeds is turned into the soil, without first cutting and drying, the soil will be much more likely to be soured than would be the case if the weeds are cut and dried partially before turning. Under no circumstances should a dense growth of weeds be turned in to form a layer, three or more inches below the

surface, that will cut off the movement of the water from below to the surface. If this is done the wheat will likely suffer from an insufficient supply of moisture and the results generally will not be satisfactory.

The organic material turned under should be so handled that it will have time to thoroughly decompose and be thoroughly incorporated with the top few inches of soil. Where the land is broken in the way suggested above and allowed to settle for three to four weeks before seeding, there should be no difficulty in getting a good seed-bed and a good stand of wheat, provided other conditions are made satisfactory for germination of the seed.

SOWING THE SEED

Heavy and plump kernels, free from dirt and foreign seeds, should be used for seeding, as they germinate quicker and produce much hardier and stronger plants, which are usually much more productive than those grown from small light or immature seed. In North Carolina the seeding should take place as soon as possible after the first light frost. If sown before that time the wheat is liable to be injured in localities where the Hessian fly is troublesome. After a well-prepared seed-bed has been provided, the seeding should take place at the rate of 6 to 8 pecks per acre. On poor land and stiff clay soils, the seeding should be heavier than on fertile and loamy soils. If the seed are sown late or be broadcast by hand, it will usually require more seed than where the seeding is early or they are put in with a drill. Varieties with large kernels or with limited stooling capacity should be seeded at a heavier rate than those with small seed or with a strong tendency to stool or tiller.

The depth of seeding should be governed by the texture and moisture content of the soil. Under favorable conditions, a depth of one inch or less will be ample, but where the soil is loose, dry and lumpy a slightly deeper seeding will frequently be advisable. Usually the seed are covered to a depth of one to two inches; deep enough to be deposited in moist soil. It often pays to harrow the ground after the grain is sown in order to make the soil compact below and fine and mellow at the surface.

ROTATIONS

With wheat as with other crops a good system of rotations is one of the essentials of success. The system of rotation should be so planned that a liberal supply of nitrogen, the most costly fertilizing constituent, will be abundantly stored in the soil by the growth of nitrogen-gathering crops like cowpeas, hairy vetch, soybeans and clovers. When this is done, it will only be necessary to keep the soil

sweet by the use of lime and to maintain the supply of the far less expensive plant-food mineral constituents—phosphoric acid and potash. Wheat should be in rotation with deep-rooted crops as far as practicable as shallow-rooted plants like other small grains and corn make practically the same demands upon the soil and in the same feeding zone as does this cereal.

For the Piedmont cotton belt of the State, a good three-year rotation would be first year, wheat followed by cowpeas or soybeans; second year, cotton with crimson clover sown in it after first picking; and third year, corn followed by wheat in the fall.

For the clay and valley lands of the Piedmont and Mountain sections, excellent results are usually secured from a four-year rotation consisting of a fall-sown wheat with red clover harrowed in during the spring; red clover with the second crop turned under in the second year; and corn the fourth year. Other leguminous crops such as soybeans, hairy vetch, peanuts and velvet beans may be worked into different rotation combinations with wheat, the ones used being governed by local conditions.

The growth of wheat continuously on the same land without other crops can not be too strongly condemned, as it not only leads to reduced yields, but it is liable to leave the land in bad mechanical condition.

Photomount
Pamphlet
Binder
Gaylord Bros.
Makers
Syracuse, N. Y.
PAT. JAN 21, 1908

FOR USE ONLY IN

THE NORTH CAROLINA COLLECTION

UNIVERSITY OF N.C. AT CHAPEL HILL

00052883432

Print Stop 18527